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An Experimental Study of Affects and Associations Due to Certain Odors

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I. INTRODUCTION

A few of the experiments recorded in this monograph were carried out in the Animal Breeding Research Department of the University of Edinburgh, and thanks are due to the Director, Dr. F. A. E. Crew, for the hospitality of his department. Most of the experimental work, however, was done in the Department of Psychology, and most cordial thanks must be expressed to Dr. J. Drever for facilities afforded and for his kind interest and help. The subjects who kindly volunteered for the experiments, frequently at some personal inconvenience, are too numerous to mention individually, but their services are much appreciated. The work was further made possible by the tenure of a Carnegie Research Fellowship, and the financial aid given by the Carnegie Trust for the Universities of Scotland is most gratefully acknowledged. In 1924, the manuscript was accepted by the Faculty of Science (Edinburgh University) as a Thesis for the degree of Doctor of Philosophy.

Whilst studying a particular psychological aspect, it became necessary to obtain a view, even a very imperfect view, of the science of smell as a whole. Because of the abundance of references to chemical, physical, morphological, physiological, psychological, medical, and technological data concerning the science of smell in its widest sense, or osmics (l'osmique, osmica, Osmik)—a convenient term—it became advisable to deal with these references in a special publication from time to time. The first number of "Osmics" appeared in 1922, the second in 1924, each containing 500 bibliographical items fully indexed, which are obtainable from the publishers, Messrs. Oliver & Boyd, Edinburgh, at cost price (2 shillings each). Some of the references are rearranged, with a few additions, at the end of the monograph.

Facilities for verifying references were kindly given by the library staffs of Edinburgh and Glasgow Universities, while special indebtedness must be recorded to Mr. Alfred Ela, of Boston, Mass., and others for having supplied important references which might otherwise have escaped notice.

II. SUBJECTS, ODORS, AND METHODS EMPLOYED

Sixty-three persons, of whom twenty-nine were male and thirty-four female, kindly volunteered to act as subjects for the experiments, and are designated by numbers, 1 to 29 for male and from 30 to 63 for female subjects. In recording reactions by the same individual on different dates a letter is placed after the number.

The majority were Scottish university students, between eighteen and twenty-four years of age, and all were European. In some cases special characteristics, such as hair and eye color, presence of nasal or pharyngeal catarrh, color blindness, and other conditions were noted. It may be mentioned in passing that the presence of eye defects such as myopia, astigmatism, etc., was ascertained in as many as twenty-three out of the sixty-three subjects.

The odorous substances (osmyls) employed, twenty-six in all, were as follows: Amyl acetate, amyl alcohol, asafoetida, benzole, butyric acid, camphor, carbon bisulphide, cassia oil, cedarwood oil, citronella oil, clove oil, ethyl alcohol, eucalyptus oil, lavender oil, menthol, musk, origanum oil, orris root, pine oil (ol. pin. sylv.), rose oil (otto of roses), sandalwood oil, terebene, Tonka bean, ferric valerian, vanillin, and xylol.

For various reasons not all the subjects could be tested with all the osmyls, nor were the same series of odorous substances invariably employed in any repeat experiment with the same subject. Moreover, some subjects were tested with very few osmyls only, and some osmyls were used as stimuli only with very few subjects, so that the comparison of reactions by presenting all the reactions in percentages is not expedient in many cases. The results summarized in the tables, therefore, include reactions given on different dates by the same subject, as well as the cases in which the subject could be tested on one occassion only. In the aggregate, however, the number of reactions given is relatively large—1,444 affective and 1,296 associative reactions are tabulated—and bearing in mind the necessary reservations, it is possible to induce quite definite conclusions with regard to many points at issue.

The odorous substances were contained in small bottles or tubes, and the subjects were requested to smell the contents and to state the affect or association produced. To preclude reactions arising from visual stimuli they were further asked to close their eyes during each test, a necessary precaution indeed. Of course, no mention was made of the substances to be employed, and these were not administered in any particular order.

Owing to the phenomena of fatigue and after-smells a sufficient interval was allowed between successive stimulations. Although the stimuli were selected at random and a recuperative interval of at least two minutes duration was deemed sufficient, the adequacy of the precautions taken was tested by means of a table which clearly showed that there was no correlation whatever between the affect produced by the stimulus and the affect caused by the preceding osmyl. As was to be expected, however, the content of an association was not rarely influenced by the content of a previous association to a different stimulus in the same series of experiments, or even of associations given on a previous date.

In some cases a stop-watch was used to measure the time between the first inspiration of the stimulus and the associated word reaction, the subject holding his breath till the signal (touch or sound) was given to sniff. In a few instances the psychogalvanic reflex was observed by means of a D'Arsonval galvanometer.

Even at the risk of appearing trite, of restating obvious truisms, such as the fact that otto of roses generally produces a more pleasant sensation than does asafoetida, or that olfactory memories are often vivid, it was deemed best to undertake and interpret the experiments as far as is possible in a spirit unbiased by previous observations and conclusions, and to record the results irrespective of whether they constitute a discovery or merely a rediscovery.

III. THE AFFECTIVE OLFACTORY SYNDROME

By affect is meant here the pleasantness or unpleasantness experienced owing to an odorous stimulus. The pleasantness or unpleasantness may be due to the olfactory sensation itself or concomitant sensation (synaesthesia), or be due to a previous, associated experience or association content, or arise from a blending of past and present. Only in the case of unfamiliar odors, experienced for the first time in the course of the experiment, or where the subject was definitely aware of a difference between the direct and the associated affect, is it possible to refer the affect to the sensation experimentally produced. Even then, it is not a case of a 'pure' direct affect, since it would seem impossible to find an odor which is not somehow associated with a previous experience, of olfactory, gustatory, or other origin.

In most cases the affective judgment given by the subjects represents a blending of present and past feeling-tone. Nor is in all cases the affect static. An odor, *e.g.,* of musk, may be voted pleasant at the first whiff and then become unpleasant, a phenomenon largely, but not entirely, due to intensity, and also to concomitant sensations, for instance due to stimulation of the endings of the fifth cranial nerve. The affects recorded here represent the final judgment by the subject as to whether the odor is pleasant or unpleasant, whatever elements form the basis for the judgment, so long as the subject refers to the odor itself.

The affects are here recorded in four categories, comprising two degrees of pleasantness, entirely pleasant (+ +) and not entirely pleasant (+ —), and two degrees of unpleasantness, entirely unpleasant (— —) and not entirely unpleasant (— +). Even if there was any balancing on the knife edge of neutrality, it was found that this balancing was transient and that in all instances the affective judgment was relegated to one of the four categories.

Although discrimination between odors is largely a matter of training, reflex paths for affective reactions to olfactory stimuli are formed before birth, as is evidenced by observations on infants within the first hour after birth, such as are described by Preyer and others. Observations on animal behavior, as well as medical experience, and the history of perfumery, furnish further abundant evidence of inborn (racial) likes and dislikes to odors and of required predilections. Each individual manifests certain reactions to different olfactory stimuli based on racial and individual experience, the sum total of his likes and dislikes to odors forming an olfactory affective syndrome on diathesis expressive and characteristic of his individuality.

It would appear desirable to undertake experiments on a very large scale with subjects of widely different racial origin, Indians, Chinese, Negroes, Jews, etc., and an extensive scale of different odors to obtain the mean olfactory syndrome characteristic of the race, and to endeavor to correlate the affective judgments obtained with metabolic characteristics such as endocrine balance, pigmentation, and sex differences.

This olfactory syndrome is liable to fluctuate and be modified by various factors, such as familiarity with an odor, but particularly by changes in metabolic conditions, such as menstruation and pregnancy, and disease. The syndromes revealed by the present experiments may be studied by a perusal of the following tables, and the relative constancy, as well as the modifications in the affective judgment be seen in some of the cases.

TABLE I. THE AFFECTIVE OLFACTORY SYNDROME

SUBJECT	— —	— +	+ —	+ +
1..........	asafoetida citronella valerian	cedar rose	menthol pine sandal tonka xylol	amyl acet. camphor origanum terebene vanillin
2..........	asafoetida	valerian	amyl acet. amyl alc. citronella menthol xylol	cedar musk rose sandal terebene tonka vanillin
3..........	valerian xylol	asafoetida	cedar menthol	clove musk rose tonka
4..........	asafoetida butyric acid musk valerian	sandal	camphor cedar clove origanum pine terebene tonka vanillin xylol	amyl acet. citronella menthol rose
5..........	amyl alc. asafoetida valerian		camphor clove menthol xylol	musk orris rose tonka vanillin
6..........	asafoetida butyric acid camphor citronella origanum valerian xylol		amyl acet. amyl alc. clove ethyl alc. menthol sandal	musk pine rose terebene tonka vanillin
7..........	carb. bisulph		valerian	amyl alc. asafoetida cassia cedar citronella menthol musk pine rose sandal tonka vanillin

TABLE I. THE AFFECTIVE OLFACTORY SYNDROME—*Continued*

SUBJECT	−−	−+	+−	++
8..........	asafoetida butyric acid musk valerian	cedar	clove menthol	camphor rose tonka vanillin xylol
9..........	asafoetida camphor menthol musk pine sandal terebene valerian xylol	amyl alc. citronella clove origanum	amyl acet. cedar	rose tonka vanillin
10..........	asafoetida valerian	pine	camphor menthol musk origanum tonka	amyl acet. cedar citronella rose terebene
11..........	asafoetida valerian		cedar clove menthol musk rose tonka vanillin	camphor
12a.........	asafoetida butyric acid valerian	amyl alc. ethyl alc. clove musk	amyl. acet. camphor citronella menthol xylol	cedar orris pine rose tonka vanillin
12b.........	asafoetida valerian	clove musk	camphor xylol	cedar menthol rose tonka vanillin
12c.........	asafoetida butyric acid valerian	amyl acet. amyl alc. clove	camphor citronella menthol musk xylol	cedar tonka vanillin
12d.........	sandal	ethyl alc.	origanum	terebene

Table I. The Affective Olfactory Syndrome—*Continued*

SUBJECT	– –	– +	+ –	+ +
12e..........	asafoetida sandal valerian	ethyl alc.	amyl acet. menthol musk camphor citronella origanum	cedar pine rose terebene
12f..........	sandal		camphor menthol origanum	cedar pine terebene
12g..........	asafoetida valerian	amyl alc. clove ethyl alc. musk sandal xylol	amyl acet. camphor cedar citronella menthol origanum	pine rose terebene tonka vanillin
12h..........	asafoetida butyric acid valerian	clove xylol	amyl acet. camphor citronella ethyl alc. menthol musk origanum sandal	cedar pine rose terebene tonka vanillin
12i..........	asafoetida butyric acid valerian	amyl alc. clove ethyl alc. sandal	amyl acet. camphor citronella menthol musk origanum xylol	cedar pine rose terebene tonka vanillin
12j..........		eucalyptus	cassia	
12k..........	carb. bisulph		cassia eucalyptus	lavender
12l..........	asafoetida	valerian	amyl acet. menthol musk origanum sandal vanillin	cassia cedar citronella lavender pine rose tonka

TABLE I. THE AFFECTIVE OLFACTORY SYNDROME—*Continued*

SUBJECT	−−	−+	+−	++
12m.........	asafoetida carb. bisulph.	musk sandal	camphor cassia clove ethyl alc. eucalyptus menthol origanum	amyl acet. cedar citronella lavender pine rose terebene tonka vanillin
13..........	asafoetida camphor citronella sandal valerian	cedar origanum xylol	clove menthol pine rose terebene vanillin	amyl acet. musk tonka
14..........	asafoetida valerian	camphor citronella xylol	amyl acet. cedar clove menthol origanum pine sandal terebene	musk rose tonka vanillin
15..........	asafoetida clove valerian	amyl alc. camphor	menthol	musk rose tonka vanillin
16..........	asafoetida carb. bisulph. ethyl alc. sandal		benzole camphor cedar citronella eucalyptus menthol musk origanum pine valerian	amyl acet. cassia clove lavender rose terebene
17..........	asafoetida carb. bisulph. valerian			amyl acet. citronella clove eucalyptus rose

TABLE I. THE AFFECTIVE OLFACTORY SYNDROME—*Continued*

SUBJECT	−−	−+	+−	++
18..........	amyl alc. asafoetida	camphor menthol valerian xylol		cedar clove musk orris rose tonka vanillin
19a.........	valerian	asafoetida	clove tonka xylol	cedar citronella musk origanum orris rose
19b.........				tonka
20..........		asafoetida butyric acid valerian	camphor citronella menthol musk origanum pine rose sandal tonka	amyl acet. clove terebene
21..........	asafoetida	valerian	camphor cedar menthol sandal	amyl acet. citronella clove ethyl alc musk origanum pine rose terebene tonka xylol
22a.........	asafoetida valerian	amyl alc. origanum xylol	camphor cedar citronella clove menthol musk pine sandal terebene tonka vanillin	amyl acet. rose

TABLE I. THE AFFECTIVE OLFACTORY SYNDROME—*Continued*

SUBJECT	− −	− +	+ −	+ +
22b..........	asafoetida valerian	camphor cedar musk sandal xylol	amyl acet. citronella origanum pine terebene tonka	clove rose
23a..........	asafoetida camphor	cedar valerian	clove menthol vanillin	musk rose tonka
23b..........		citronella origanum	camphor cedar pine	menthol terebene
24...........	amyl alc. asafoetida	vanillin	cedar clove menthol musk tonka	camphor rose
25a..........	asafoetida valerian xylol		camphor menthol pine sandal terebene tonka	amyl acet. cedar citronella clove ethyl alc. musk rose vanillin
25b..........	asafoetida xylol	amyl alc. pine	camphor menthol valerian	amyl acet. cedar citronella clove ethyl alc. musk origanum rose terebene tonka vanillin
26a..........	butyric acid	asafoetida citronella menthol valerian	ethyl alc. musk origanum pine sandal tonka xylol	amyl acet. camphor clove rose terebene vanillin

TABLE I. THE AFFECTIVE OLFACTORY SYNDROME—*Continued*

SUBJECT	− −	− +	+ −	+ +
26b	carb. bisulph valerian		cassia citronella ethyl alc. sandal xylol	musk tonka
27a	asafoetida clove		musk tonka	cedar orris rose
27b			ethyl alc. origanum	amyl acet. camphor citronella pine terebene
28	asafoetida valerian	butyric acid musk sandal	cedar clove origanum pine terebene tonka	amyl acet. citronella menthol rose vanillin
29	asafoetida musk valerian	clove	amyl alc. tonka	menthol rose
30	amyl acet. asafoetida carb. bisulph. ethyl alc. pine	musk terebene	benzole eucalyptus origanum sandal valerian	camphor cassia cedar citronella clove lavender menthol rose
31	asafoetida	butyric acid tonka xylol	amyl alc. ethyl alc. valerian vanillin	camphor cedar clove menthol musk orris rose
32a	amyl alc. asafoetida ethyl alc. valerian	musk tonka vanillin	amyl acet. cedar menthol origanum sandal terebene	camphor citronella pine rose

TABLE I. THE AFFECTIVE OLFACTORY SYNDROME—*Continued*

SUBJECT	– –	– +	+ –	+ +
32b..........	amyl alc. valerian	terebene tonka vanillin	amyl acet. cedar clove musk origanum sandal xylol	camphor citronella pine rose
33..........	asafoetida valerian	cedar citronella ethyl alc. musk sandal	amyl acet. clove menthol origanum pine tonka xylol	camphor rose terebene vanillin
34a..........	asafoetida musk	valerian	tonka vanillin	camphor menthol rose
34b..........	cedar clove musk	tonka vanillin	valerian	camphor menthol rose xylol
34c..........	asafoetida carb. bisulph. origanum			amyl acet. camphor cassia clove lavender menthol rose
35..........	amyl alc. asafoetida clove ethyl alc. valerian	cedar xylol	camphor menthol musk orris tonka	rose vanillin
36a..........	asafoetida lavender sandal valerian vanillin		musk	amyl acet. camphor cassia cedar citronella eucalyptus origanum rose tonka
36b..........	musk			

TABLE I. THE AFFECTIVE OLFACTORY SYNDROME—*Continued*

SUBJECT	– –	– +	+ –	+ +
37..........	asafoetida carb. bisulph sandal valerian	benzole camphor cedar citronella ethyl alc. lavender pine	amyl acet. menthol musk terebene	cassia clove eucalyptus origanum rose
38a..........		asafoetida camphor cedar menthol origanum pine sandal valerian xylol	amyl alc. clove musk tonka vanillin	amyl acet. citronella rose terebene
38b..........	asafoetida valerian	camphor cedar ethyl alc. musk pine sandal tonka xylol	clove menthol origanum terebene vanillin	amyl acet. citronella rose
39a..........	asafoetida tonka	cedar valerian xylol	clove	menthol orris rose
39b..........	asafoetida butyric acid valerian	clove sandal	camphor cedar citronella ethyl alc. origanum terebene tonka	amyl acet. menthol musk pine rose vanillin
40a..........	asafoetida carb. bisulph. xylol	cedar pine sandal valerian	cassia citronella eucalyptus lavender menthol musk terebene vanillin	amyl acet. camphor origanum rose
40b..........			pine	

TABLE I. THE AFFECTIVE OLFACTORY SYNDROME—*Continued*

SUBJECT	— —	— +	+ —	+ +
41a.	asafoetida butyric acid valerian	amyl alc. camphor clove ethyl alc. musk	cedar citronella menthol pine xylol vanillin	orris rose tonka
41b..........	amyl alc. asafoetida	camphor clove musk valerian	cedar menthol xylol vanillin	rose tonka
42a..........	asafoetida benzole carb. bisulph. ethyl alc. valerian	amyl acet. camphor cedar citronella pine	cassia musk sandal terebene	clove eucalyptus lavender menthol origanum rose
42b..........	asafoetida benzole carb. bisulph. valerian	cedar citronella ethyl alc. sandal	camphor lavender musk pine terebene	amyl acet. cassia clove eucalyptus menthol origanum rose
43a..........	asafoetida valerian	cedar pine vanillin	camphor citronella clove origanum tonka xylol	amyl acet. ethyl alc. menthol musk rose sandal terebene
43b........	asafoetida valerian	xylol	musk	camphor citronella clove menthol origanum pine rose sandal tonka
44...........		valerian	menthol musk xylol	camphor cedar rose tonka vanillin

TABLE I. THE AFFECTIVE OLFACTORY SYNDROME—*Continued*

SUBJECT	− −	− +	+ −	+ +
45a..........	asafoetida valerian	musk sandal	camphor cedar clove pine xylol	amyl acet. citronella menthol origanum rose terebene tonka vanillin
45b..........	carb. bisulph. sandal	cedar valerian	camphor cassia clove musk tonka xylol	citronella eucalyptus lavender rose
45c..........	carb. bisulph. valerian	musk		amyl acet. camphor cassia citronella clove eucalyptus lavender origanum
46...........	carb. bisulph. valerian	asafoetida cedar pine sandal	eucalyptus musk vanillin	amyl acet. camphor cassia citronella lavender menthol origanum rose terebene tonka xylol
47a..........	asafoetida carb. bisulph. cedar citronella sandal	musk	benzole camphor ethyl alc. lavender menthol valerian	amyl acet. cassia clove eucalyptus origanum pine rose terebene
47b..........	valerian		citronella ethyl alc. musk rose	benzole camphor cassia cedar menthol pine

TABLE I. THE AFFECTIVE OLFACTORY SYNDROME—*Continued*

UBJECT	−−	−+	+−	++
48..........	camphor carb. bisulph. ethyl alc. valerian	asafoetida citronella musk origanum pine	benzole cedar clove eucalyptus lavender menthol sandal terebene	amyl acet. cassia rose
49..........		amyl alc.	camphor musk tonka valerian vanillin	asafoetida clove menthol rose
50a.........	asafoetida carb. bisulph. sandal valerian		cedar ethyl alc. menthol musk rose	amyl acet. benzole camphor cassia citronella clove eucalyptus lavender origanum pine terebene
50b.........	asafoetida sandal valerian		cedar pine	amyl acet. cassia citronella eucalyptus lavender musk
51a.........	asafoetida valerian	camphor clove sandal	amyl alc. menthol pine tonka xylol	amyl acet. cedar citronella ethyl alc. musk origanum rose terebene vanillin
51b.........	asafoetida ethyl alc. valerian	amyl alc. camphor cedar xylol	clove pine	amyl acet. citronella menthol musk origanum rose sandal terebene tonka vanillin

TABLE I. THE AFFECTIVE OLFACTORY SYNDROME—*Continued*

SUBJECT	– –	– +	+ –	+ +
52a	cedar musk xylol	amyl alc. asafoetida ethyl alc. menthol valerian	amyl acet. camphor origanum pine vanillin	citronella rose sandal terebene tonka
52b	carb. bisulph. cedar musk sandal	valerian	camphor cassia eucalyptus terebene	citronella lavender rose
53a	asafoetida pine	amyl acet. cedar citronella clove rose valerian	camphor menthol musk origanum sandal terebene xylol	tonka vanillin
53b	asafoetida sandal	amyl acet. cedar clove ethyl alc. musk pine rose valerian xylol	amyl alc. camphor citronella menthol origanum terebene tonka	vanillin
54	valerian	amyl acet. camphor xylol	amyl alc. asafoetida cedar ethyl alc. musk origanum pine sandal	citronella clove menthol rose terebene tonka vanillin
54b	valerian	camphor cedar menthol origanum sandal	amyl acet. citronella clove musk pine terebene	rose vanillin
55	asafoetida carb. bisulph. valerian	ethyl alc. origanum sandal	benzole cedar clove musk pine terebene	amyl acet. camphor cassia citronella eucalyptus lavender menthol rose

TABLE I. THE AFFECTIVE OLFACTORY SYNDROME—*Continued*

SUBJECT	−−	−+	+−	++
56..........	amyl alc. asafoetida	musk tonka valerian	camphor cedar menthol	rose vanillin
57a.........	asafoetida carb. bisulph. citronella origanum sandal valerian	pine	benzole camphor cedar ethyl alc. menthol	amyl acet. cassia clove eucalyptus lavender musk rose terebene
57b.........	asafoetida carb. bisulph. musk valerian			amyl acet. eucalyptus lavender rose
58..........	asafoetida musk		camphor valerian vanillin	menthol rose tonka
59a.........	valerian	musk	asafoetida cedar pine sandal	amyl acet. camphor citronella clove menthol origanum rose terebene tonka vanillin xylol
59b.........		valerian	asafoetida cedar musk pine	amyl acet amyl alc. camphor citronella clove menthol origanum rose sandal terebene tonka vanillin xylol

TABLE I. THE AFFECTIVE OLFACTORY SYNDROME—*Concluded*

SUBJECT	−−	−+	+−	++
59c.	carb. bisulph		cedar musk valerian	camphor cassia citronella eucalyptus lavender sandal tonka
60a.	asafoetida carb. bisulph. musk	clove eucalyptus menthol	camphor origanum pine tonka valerian vanillin xylol	cassia cedar citronella lavender rose sandal terebene
60b.	cassia menthol valerian	musk	cedar origanum pine	citronella lavender rose tonka
61.	valerian	citronella origanum xylol	amyl acet. asafoetida camphor cedar menthol musk pine	clove ethyl alc. rose terebene tonka vanillin
62.	origanum valerian	asafoetida clove musk	amyl acet. butyric acid cedar ethyl alc. camphor menthol pine sandal vanillin xylol	citronella rose terebene tonka
63.	asafoetida carb. bisulph. cedar valerian			amyl acet. eucalyptus origanum rose

IV. AFFECTIVE REACTIONS TO THE DIFFERENT OSMYLS

If the data contained in the table showing the olfactory syndrome are grouped according to the osmyls, it becomes evident that certain odorous substances will be responsible for a more or less uniform affective reaction, such as rose oil and carbon bisulphide, while others, like musk and sandalwood oil, reveal a considerable variation. In all cases in which a sufficient number of observations are available, however, it is demonstrable that affective judgments are not given hapazard, but are characteristic of the stimlus, and may be expressed by the mean affective reaction, in terms of the four affective categories used in the experiments. Another way would be to determine the percentage of pleasant reactions, combining $++$ and $+-$, of the different osmyls, and so arriving at a definite order of preference. This order of preference represents, as it were, the crest of the wave of votes travelling from 100 per cent. pleasant odors, like orris root and rose to the 0 per cent. of carbon bi-sulphide.

A table, given further on (II), shows which subjects are responsible for the different affective reactions due to each osmyl and represents, almost graphically, the frequency distribution of affective judgment, at least where there is an adequate number of observations. Another table (III) summarizes the number of reactions given in each category. Table IV shows the mean affect, the percentage of pleasant reactions, and the approximate order of preference. The order is only approximate because of the relatively small number of observations and the inclusion of repeat experiments, but it may be noted here, that fifteen subjects who were asked to arrange the phials containing the osmyls in order of smell preference showed a series not differing very widely from the order of preference given here. A substance very difficult to place is musk, owing to the considerable fluctuations in the affective reaction by the same subject at different times.

The Tables reveal the salient fact that sex differences are present with regard to affective judgments to certain odors, while other osmyls cause the same affect in both sexes. There appears to be a tendency for camphor, menthol, citronella, and ferric valerian to be relatively preferred by females, while cedarwood oil, pine oil, musk, and tonka bean are more favored by males. The tendency to sex difference in affective reactions would become more clearly indicated, provided a larger number of subjects were examined.

Male subjects appear to give a somewhat higher percentage of pleasant reactions (69.7) than do female subjects (65.5). Marked deviations from the mean affect may also be indicative of sex difference, 19.3 per cent. of the reactions being unusual in the case of the female, and only 13.6 per cent. in the case of the male. Another observation, though perhaps equally open to criticism, shows that while there were 12 out of the 46 male syndromes manifesting 3 and more unusual reactions per syndrome, 34 out of 54 female syndromes had 3 and more unusual reactions. There is no doubt, though, that the experiments do show a considerable difference between the sexes as regards affective judgment to odors, whereas a differentiation is not *clearly* evident in the associative reactions to be discussed later.

As one of the factors on which the affect depends is the intensity of the stimulus, one may deduce that there exist sexual differences in keenness of smell. This deduction is corroborated by actual measurements of olfactory acuity by Bailey, Ottolenghi, Vaschide, and others. Marro who tested a large number of young subjects, found that the sense of smell after puberty is generally more acute in women than in men, which may partly explain the lower percentage of pleasant reactions in female subjects recorded in the present experiments.

TABLE IIa. AFFECTIVE JUDGMENT BY MALE SUBJECTS

OSMYL	− −	− +	+ −	+ +
Amyl acetate.		12	2 6 9 12 12 12 12 12 12 14 22	1 4 10 12 13 16 17 20 21 22 25 25 26 27 28
Amyl alcohol.	5 18 24	9 12 12 12 12 15 22 25	2 6 29	7
Asafoetida....	1 2 4 5 6 8 9 10 11 12 12 12 12 12 12 12 12 12 13 14 15 16 17 18 21 22 22 23 24 25 25 27 28 29	3 19 20 26		7
Benzole......			16	
Butyric acid..	4 6 8 12 12 12 12 26	20 28		
Camphor.....	6 9 13 23	14 15 18 22	4 5 10 12 12 12 12 12 12 12 12 12 16 20 21 22 23 25 25	1 8 11 24 26 27
Carbon bisulphide...	7 12 12 16 17 26			
Cassia oil			12 12 12 26	7 12 16
Cedarwood oil.........		1 8 13 22 23	3 4 9 11 12 14 16 21 22 23 24 28	2 7 10 12 12 12 12 12 12 12 12 12 18 19 25 25 27
Citronella....	1 6 13	9 14 23 26	2 12 12 12 12 12 12 16 20 22 22 26	4 7 10 12 12 17 19 21 25 25 27 28
Clove oil.....	15 27	9 12 12 12 12 12 12 29	4 5 6 8 11 12 13 14 19 22 23 24 28	3 16 17 18 20 21 22 25 25 26
Ethyl alcohol.	16	12 12 12 12 12	6 12 12 26 26 27	21 25 25

TABLE IIa. AFFECTIVE JUDGMENT BY MALE SUBJECTS—*Continued*

OSMYL	−−	−+	+−	++
Eucalyptus oil.........		12	12 12 16	17
Lavender oil..				12 12 12 16
Menthol......	9	18 26	1 2 3 5 6 8 10 11 12 12 12 12 12 12 12 12 12 13 14 15 16 20 21 22 23 24 25 25	4 7 12 23 28 29
Musk........	4 8 9 29	12 12 12 12 22 28	10 11 12 12 12 12 12 16 20 22 24 26 27	2 3 5 6 7 13 14 15 18 19 21 23 25 25 26
Origanum oil..	6	9 12 22 23	4 10 12 12 12 12 12 12 12 12 14 16 20 22 26 27 28	1 19 21 25
Orris root.....				5 12 18 19 27
Pine oil......	9	10 25	1 4 13 14 16 20 22 22 23 25 26 28	6 7 12 12 12 12 12 12 12 12 12 27
Rose oil......		1	11 13 20	2 3 4 5 6 7 8 9 10 12 12 12 12 12 12 12 12 14 15 16 17 18 19 21 22 22 23 24 25 25 26 27 28 29
Sandalwood oil.........	9 12 12 12 13 16	4 12 12 12 22 28	1 6 12 12 14 20 21 22 25 26 26	2 7
Terebene.....	9		4 13 14 22 22 25 28	1 2 6 10 12 12 12 12 12 12 12 16 20 21 23 25 26 27

TABLE IIa. AFFECTIVE JUDGMENT BY MALE SUBJECTS—*Concluded*

OSMYL	−−	−+	+−	++
Tonka bean...			1 4 10 11 19 20 22 22 24 25 26 27 28 29	2 3 5 6 7 8 9 12 12 12 12 12 12 12 12 13 14 15 18 19 21 23 25 26
Ferric valerian....	1 3 4 5 6 8 9 10 11 12 12 12 12 12 12 12 13 14 15 17 19 22 22 25 26 28 29	2 12 18 20 21 23 26	7 16 25	
Vanillin......		24	4 11 12 13 22 23	1 2 5 6 7 8 9 12 12 12 12 12 12 12 14 15 18 25 25 26 28
Xylol........	3 6 9 25 25	12 12 13 14 18 22 22	1 2 4 5 12 12 12 12 19 26 26	8 21

TABLE IIb. AFFECTIVE JUDGMENT BY FEMALE SUBJECTS

OSMYL	− −	− +	+ −	+ +
Amyl acetate.	30	42 53 53 54	32 32 33 37 52 54 61 62 45 45 46 47	34 36 38 38 39 40 42 43 45 45 46 47 48 50 50 51 51 55 57 57 59 59 63
Amyl alcohol..	32 32 35 41	41 49 51 52	31 38 51 53 54	59
Asafoetida....	30 31 32 33 34 34 35 36 37 38 39 39 40 41 41 42 42 43 43 45 47 50 50 51 51 53 53 55 56 57 57 58 60 63	38 46 48 52 62	54 59 59 61	49
Benzole......	42 42	37	30 47 48 55 57	47 50
Butyric acid..	39 41	31	62	
Camphor.....	48	37 38 38 41 41 42 51 51 54 54	35 39 42 43 45 45 47 49 52 52 53 53 56 57 58 60 61 62	30 31 32 32 33 34 34 34 36 40 43 44 45 46 47 50 55 59 59 59
Carbon bisulphide...	30 34 37 40 42 42 45 45 46 47 48 50 52 55 57 57 59 60 63			
Cassia oil....			40 42 45 52	30 34 36 37 42 45 46 47 47 48 50 50 55 57 59 60
Cedarwood oil	34 47 52 52 63	33 35 37 38 38 39 40 42 42 43 45 46 51 53 53 54	32 32 39 41 41 45 48 50 50 54 55 56 57 59 59 59 60 61 62	30 31 36 44 47 51 60

Table IIb. Affective Judgment by Female Subjects—*Continued*

OSMYL	− −	− +	+ −	+ +
Citronella....	47 57	33 37 42 42 48 53 61	39 40 41 43 47 53 54	30 32 32 36 38 38 43 45 45 45 46 50 50 51 51 52 52 54 55 59 59 59 60 60 62
Clove oil.....	34 35	39 41 41 51 53 53 60 62	32 33 38 38 39 43 45 45 48 51 54 55	30 31 34 37 42 42 43 45 47 49 50 54 57 59 59 61
Ethyl alcohol.	30 32 35 42 48 51	33 37 38 41 42 52 53 55	31 39 47 47 50 54 57 62	43 51 61
Eucalyptus oil.........		60	30 40 46 48 52	36 37 42 42 45 45 47 50 50 55 57 57 59 63
Lavender oil..	36	37	40 42 47 48	30 34 42 45 45 46 50 50 52 55 57 57 59 60 60
Menthol......	60	38 52 54 60	32 33 35 37 38 40 41 41 44 47 48 50 51 52 53 56 57 61 62	30 31 34 34 34 39 39 42 42 43 43 45 46 47 49 51 54 55 58 59 59
Musk........	34 34 36 52 52 57 58 60	30 32 33 38 41 41 45 45 47 48 53 56 59 60 62	32 35 36 37 38 40 42 42 43 44 45 46 47 49 50 53 54 54 55 59 59 61	31 39 43 50 51 51 57
Origanum oil..	34 57 62	38 48 54 55 61	30 32 32 33 38 39 43 52 53 53 54 60 60	36 37 40 42 42 43 45 45 46 47 50 51 51 59 59 63
Orris root.....			35	31 39 41
Pine oil......	30 53	37 38 38 40 42 43 46 48 53 57	33 40 41 42 45 50 51 51 52 54 54 55 59 59 60 60 61 62	32 32 39 43 47 47 50

TABLE IIb. AFFECTIVE JUDGMENT BY FEMALE SUBJECTS—*Concluded*

OSMYL	– –	– +	+ –	+ +
Rose oil......		53 53	47 50	30 31 32 32 33 34 34 34 35 36 37 38 38 39 39 40 41 41 42 42 43 43 44 45 45 46 47 48 49 51 51 52 52 54 54 55 56 57 57 58 59 59 60 60 61 62 63
Sandalwood oil.........	36 37 45 47 50 50 52 53 57	33 38 38 39 40 42 45 46 51 54 55	30 32 32 42 48 53 54 59 62	43 43 51 52 59 59 60
Terebene.....		30 32	32 37 38 39 40 43 43 48 52 53 53 54 55	33 38 43 45 46 47 50 51 51 52 54 57 59 59 60 61 62
Tonka bean....	39	31 32 32 34 38 56	33 34 35 38 39 43 45 49 51 53 60	36 41 41 43 44 45 46 51 52 53 54 58 59 59 59 60 61 62
Ferric valerian....	32 32 33 35 36 37 38 39 41 42 42 43 43 45 45 46 47 48 50 50 51 51 54 54 55 57 57 59 60 61 62 63	34 38 39 40 41 44 45 52 52 53 53 56 59	30 31 34 47 49 58 59 60	
Vanillin......	36	32 32 34 43	31 34 38 38 40 41 41 46 49 52 58 60 62	33 35 39 44 45 51 51 53 53 54 54 56 59 59 61
Xylol........	40 52	31 35 38 38 39 43 51 53 54 61	32 33 41 41 43 44 45 45 51 53 60 62	34 46 59 59

TABLE III. THE NUMBER OF AFFECTIVE REACTIONS

OSMYL	Male				Female				Total			
	--	-+	+-	++	--	-+	+-	++	--	-+	+-	++
Amyl acetate	0	1	11	15	1	4	8	23	1	5	19	38
Amyl alcohol	3	8	3	1	5	4	5	1	8	12	8	2
Asafoetida	34	4	0	1	34	5	4	1	68	9	4	2
Benzole	0	0	1	0	2	1	5	2	2	1	6	2
Butyric acid	8	2	0	0	2	1	1	0	10	3	1	0
Camphor	4	4	19	6	1	10	18	20	5	14	37	26
Carbon bisulphide	6	0	0	0	19	0	0	0	25	0	0	0
Cassia oil	0	0	4	3	1	0	4	16	1	0	8	19
Cedarwood oil	0	5	12	17	5	16	19	7	5	21	31	24
Citronella	3	4	12	12	2	7	7	25	5	11	19	37
Clove oil	2	8	13	10	2	8	12	16	4	16	25	26
Ethyl alcohol	1	5	6	3	6	8	8	3	7	13	14	6
Eucalyptus oil	0	1	3	1	0	1	5	14	0	2	8	15
Lavender oil	0	0	0	4	1	1	4	15	1	1	4	19
Menthol	1	2	28	6	1	4	19	21	2	6	47	27
Musk	4	6	13	15	8	15	22	7	12	21	35	22
Origanum oil	1	4	17	4	3	5	13	16	4	5	30	20
Orris root	0	0	0	5	0	0	1	3	9	0	1	8
Pine oil	1	2	12	12	2	10	18	7	3	12	30	19
Rose oil	0	1	3	34	0	2	2	47	0	3	5	81
Sandalwood oil	6	6	11	2	9	11	9	7	15	17	20	9
Terebene	1	0	7	18	0	2	13	17	1	2	20	35
Tonka bean	0	0	14	24	1	6	11	18	1	6	25	42
Ferric valerian	27	7	3	0	32	13	8	0	59	20	11	0
Vanillin	0	1	6	21	1	4	13	15	1	5	19	36
Xylol	5	7	11	2	2	10	12	4	7	17	23	6
Total reactions	610				834				1444			

Table IVa.

Mean Affect, Percentage of Pleasant Reactions, and Approximate Order of Preference

OSMYL	MALE SUBJECTS	
	MEAN AFFECT	% pl. REACTIONS
Amyl acetate	++	95.9
Amyl alcohol	−+	26.6
Asafoetida	−−	2.6
Benzole	+−	
Butyric acid	−−	
Camphor	+−	75.7
Carbon bisulphide	−−	0
Cassia oil	+− (to ++)	100
Cedarwood oil	+− (to ++)	85.3
Citronella	+−	77.4
Clove oil	+−	69.7
Ethyl alcohol	+−	60
Eucalyptus oil	+−	80
Lavender oil	++	100
Menthol	+−	91.6
Musk	+−	73.6
Origanum oil	+−	80.8
Orris root	++	100
Pine oil	+−	88.8
Rose oil	++	97.4
Sandalwood oil	+− (to −+)	52
Terebene	++	96.1
Tonka bean	++	100
Ferric valerian	−−	8.1
Vanillin	++	96.4
Xylol	+− (to −+)	52
Percentage of total pleasant reactions (all osmyls)		69.7% 425/610

TABLE IVb.

MEAN AFFECT, PERCENTAGE OF PLEASANT REACTIONS, AND APPROXIMATE ORDER OF PREFERENCE.

OSMYL	FEMALE SUBJECTS	
	MEAN AFFECT	% pl. REACTIONS
Amyl acetate	++	86.1
Amyl alcohol	−+	40
Asafoetida	−−	11.4
Benzole	+−	
Butyric acid	−−	
Camphor	+−	77.5
Carbon bisulphide	−−	0
Cassia oil	++	95.2
Cedarwood oil	+− (to −+)	55.3
Citronella	++	78.0
Clove oil	+−	73.7
Ethyl alcohol	−+	44.
Eucalyptus oil	++	95
Lavender oil	++	90.5
Menthol	+− (to ++)	91.9
Musk	+− (to −+)	55.8
Origanum oil	+−	78.4
Orris root	++	100
Pine oil	+−	67.5
Rose oil	++	96.1
Sandalwood oil	−+ (to +−)	44.4
Terebene	++	93.7
Tonka bean	++ (to +−)	80.5
Ferric valerian	−−	15.1
Vanillin	++ (to +−)	84.8
Xylol	+− (to −+)	57.1
Percentage of total pleasant reactions (all osmyls)		65.5% 546/834

TABLE IVc.

MEAN AFFECT, PERCENTAGE OF PLEASANT REACTIONS, AND APPROXIMATE ORDER OF PREFERENCE

OSMYL	TOTAL		ORDER OF PREF.
	MEAN AFFECT	% pl. REACT.	
Amyl acetate	++	90.5	8
Amyl alcohol	−+	33.3	22
Asafoetida	−−	7.2	24
Benzole	+−	72.7	15
Butyric acid	−−	7.1	25
Camphor	+−	76.8	13
Carbon bisulphide	−−	0	26
Cassia oil	++	96.4	3
Cedarwood oil	+−	67.9	17
Citronella	++	77.7	12
Clove oil	+−	71.8	16
Ethyl alcohol	+− (to −+)	50	20
Eucalyptus oil	++	92	6
Lavender oil	++	92	5
Menthol	+−	90.2	9
Musk	+−	63.3	18
Origanum oil	+−	79.4	11
Orris root	++	100	2
Pine oil	+−	76.5	14
Rose oil	++	96.7	1
Sandalwood oil	+− (to −+)	47.5	21
Terebene	++	93.5	4
Tonka bean	++	90.5	7
Ferric valerian	−−	12.2	23
Vanillin	++	90.1	10
Xylol	+−	54.7	19

V. UNUSUAL AFFECTIVE JUDGMENTS

Out of the total of 1,444 affective judgments recorded, 244 or 16.8 per cent. showed a marked deviation from the mean affect, and are summed up in Table V. It has already been remarked that 13.6 per cent. of the male and 19.3 per cent. of the female reactions deviated from the mean affect, that is to say, from the mean affect for each sex. No deviations were observed in the case of carbon bisulphide and orris root, and the greatest variability with musk, sandalwood oil, cedarwood oil, camphor, and citronella. As will be gleaned from the Table, five and less of the sixty-three subjects were responsible for deviations in each of about half the number of osmyls tested.

The number of syndromes in which unusual reactions were noted was as follows:

Unusual per Syndrome	0	1	2	3	4	5	6	7	8	9	10
Male Syndromes (46)........	9	13	12	6	3	1	1	0	0	0	1
Female Syndromes (54)......	2	10	8	11	7	7	5	3	0	1	0
Total (100)................	11	23	20	17	10	8	6	3	0	1	1

The sexual differentiation has already been commented on.

In order to discover whether there was any demonstrable correlation between an unusual reaction due to one odor and unusual reaction at the same time due to another odor, the number of such reactions is shown in Table VI. Thus, there were 7 tests (syndromes) in which musk gave the only reaction markedly deviating from the mean; there were 11 tests (syndromes) in which an unusual reaction due to cedarwood oil coincided with an unusual reaction to musk; and so on. However, no valid conclusions can be drawn from this table.

If one examines Tables IIa and IIb, one is compelled to ask for the reason or reasons why a particular subject gives affective reactions to olfactory stimuli that differ from those experienced by the majority of other subjects. Is it due to a personal idiosyncrasy? A convenient if sometimes a nugatory explanation. Is it due to some particular association as is commonly held?

Or, is it a case of abnormality, such as parosmia? Or is it due to other factors? While it has not been found possible to satisfactorily explain all, or even a large percentage of the unusual affective reactions, yet an examination of certain instances in which other factors were noted, may throw some light on this problem.

Subjects Nos. 12, 30, 42, 53, and 54, found that amyl acetate was unpleasant. In the case of 12, and 42, it is noteworthy that they experienced a pleasant affect on another date. The odor of amyl acetate is usually associated with the flavor of smell of pears, " pear-drops," and other sweets, and sometimes with that of ether, benzole, or absolute alcohol. In all these unusual cases, the association did not differ essentially from the association experienced with the " normal " affective reaction. However, these five

Table V. Unusual Affective Judgments

	Male Reactions	Female Reactions	Total Reactions	Number of Subjects Involved
Amyl acetate	1	5	6	5
Amyl alcohol	4	6	10	10
Asafoetida	1	5	6	5
Benzole	0	3	32	2
Butyric acid	0	1	1	1
Camphor	8	11	19	15
Carbon bisulphide	0	0	0	0
Cassia oil	0	1	1	1
Cedarwood oil	5	12	17	16
Citronella	7	9	16	15
Clove oil	10	10	20	13
Ethyl alcohol	4	9	13	11
Eucalyptus oil	1	1	2	2
Lavender oil	0	2	2	2
Menthol	3	5	8	7
Musk	10	15	25	18
Origanum oil	5	8	13	13
Orris root	3	12	15	13
Pine oil	3	12	15	13
Rose oil	1	2	3	4
Sandalwood oil	8	16	24	18
Terebene	1	2	3	3
Tonka bean	0	7	7	6
Ferric valerian	3	8	11	11
Vanillin	1	5	6	5
Xylol	7	6	13	11
Total	83	161	244	
All reactions	610	834	1444	
Unusual reactions	13.6%	19.3%	16.8%	

subjects all experienced a disagreeable laryngeal sensation, "the smell catches the throat," a sensation which occurs when amyl acetate is vigorously inhaled either via the nose or by the mouth. Hence the unpleasant affect in these cases, which cannot be regarded as being abnormal, and, in cases pleasantly affected also affording a reason for the occasional association of the "smell" of amyl acetate with that of benzole, which is liable to cause a similar laryngeal reflex and sensation.

It will be noted that subjects 7 and 59, display an unusual liking for amyl alcohol, asafoetida, sandalwood oil and ferric valerian, a combination of unusual reactions which does not occur in any of the other subjects, although, especially in cases of nasal catarrh (absent in 7 and 59), unpleasant odors may appear faint enough

Table VI.

Correlation Between Two Unusual Affective Reactions

	Amyl acetate	Amyl alcohol	Asafoetida	Benzole	Butyric acid	Camphor	Carbon bisulph	Cassia oil	Cedarwood oil	Citronella	Clove oil	Ethyl alcohol	Eucalyptus oil	Lavender oil	Menthol	Musk	Origanum	Orris root	Pine oil	Rose oil	Sandalwood oil	Terebene	Tonka bean	Ferric valerian	**Vanillin**	Xylol
Amyl acetate		2	2			2			2	2	2	2				3			4	2	1	1				2
Amyl alcohol	2		3			4			2	2	1	1			2		2		1		3		1	2		4
Asafoetida	2	3				2			1	2		2				1	1		1		2			2		2
Benzole						1			2	2				1					1		1					
Butyric acid										1						1	1									
Camphor	2	4	2	1					10	5	5	4		1	4	6	6		6		4	1	1			10
Carbon bisulphide																										
Cassia oil															1	1										
Cedarwood oil	2	2	1	2		10			1	8	4	5		1	3	11	4		10	3	9		3	2	2	10
Citronella	2	2	2	2	1	5			8	1	2	2		1	3	4	8		5	2	5	11		1		5
Clove oil	2	1				5			4	2	2	2	1		2	8	1		3	2	3	1	1	2	1	5
Ethyl alcohol	2	1	2			4			5	2	2	1			1	2	2		4		3	1	1	1	2	4
Eucalyptus oil											1		1		1	1			1			1		2		1
Lavender oil				1		1			1	1									1		2				1	
Menthol		2				4		1	3	3	2	1	1			3	3		3		3	2		1		4
Musk	3		1		1	6		1	11	4	8	2	1		3	7	3		4	1	6	1	4	4	2	6
Origanum oil		2	1		1	6			4	8	1	2			3	3	2		4		4	1				6
Orris root																										
Pine oil	4	1	1	1		6			10	5	3	4	1	1	3	4	4		1	2	4	1	1	1	1	5
Rose oil	2								3	2	2					1			2		1					1
Sandalwood oil	1	3	2	1		4			9	5	3	3		2	3	6	4		1	1	5			5	2	3
Terebene	1					1				1	1	1	1		2	1	1		1				1		1	1
Tonka bean		1				1			3		1	1				4			1			1		2	3	3
Ferric valerian		2	2						2	1	2	1	2		1	4			1		5		2		1	2
Vanillin									2		1	2		1		2			1		2	1	3	1	1	
Xylol	2	4	2			10			10	5	5	4	1		4	6	6		5	1	3	1	3	2		1

not to be unpleasant. These two subjects had one factor in common which may be tentatively put forward as an explanation, they were both red-green color blind. Subject No. 51 is red-green color-weak, and No. 21 blue-green slightly weak.

The olfactory mucus membrane, like the retina, is pigmented, and it has been observed on the one hand, that albinos are unable to distinguish smells and may be altogether anosmic, and on the other that animals with a darkly pigmented olfactory mucus membrane (*e.g.* the dog) have a keen sense of smell. In addition, there are the vibrations of light and the molecular vibrations of odorous molecules (according to Heyninx), the sensations in both cases depending on wave-lengths. It is not unreasonable to put forward the hypothesis, which requires new physiological, histological, and chemical research, that abnormalities in the pigmentation are correlated with each other and with abnormalities of sensation. Abnormalities of sensation, again, may and often do cause unusual affective reactions.

A somewhat more evident cause for unusual reactions and fluctuations of the affect is afforded by catarrhal conditions of the nose and nasopharynx. Subjects 12g, 13, 23a, 34b, 43b, and 54a, were suffering from a cold at the time of the experiment. Their affective reactions are shown in Table I.

Nasal conditions are closely related to sexual metabolism, and many of the affective fluctuations recorded in these experiments are due to this correlation. It was not expedient to obtain data with regard to catamenial phenomena, except in one case. The latter a week before judged musk to be — +, when "not feeling well" the affect was + — and a week after, again — +. The affect due to ferric valerian was found to be — —, then — + and again — —, on the same dates. Similar fluctuations were observed in subjects complaining of a very slight cold (catamenial engorgement of nasal mucosa) or headache. Smoking does not appear to have any noticeable influence on the affective reactions given.

Subjects Nos. 9 and 53 were not in very good health, and both had rather a dislike to odors in general, the former subject in addition being responsible for an excessive number of egocentric associative reactions.

The deviations from the mean affect observed in the case of reactions to rose oil provided an interesting example of deviation due to association. The affect is so uniformly entirely pleasant that even a + — reaction seemed abnormal, and a — + reaction was the occasion for some surprise. The scent of rose oil recalled in subject No. 1 the smell of burning and a serious motor car accident in which the subject had received an injury causing atrophy of the optic nerve of the left eye. The content of this associative reaction was extremely large and recalled the accident which had occurred nine years previously with such vividness and intensity, that the rose affect was completely swamped. There had been a garden with roses in full bloom by the scene of the accident, as the subject remembered on introspection, but not before. It was thought at first that the accident had caused a parosmia; however, this was not the case.

Of the other exceptional reactions to rose oil, some were due to associative, others to constitutional conditions. Subject 11 had an idiosyncrasy against sweets, and both oil and vanillin were voted + — instead of + + as being too sweet. Subject 13 was suffering from a cold as was 20. Subject 53 has already been mentioned as being in indifferent health and regarded the odor as nauseating. No definite reason could be assigned to explain the reaction of 47 and 50.

Musk is the most puzzling of all the odors in the series of experiments, because both metabolic conditions and associations of an emotional nature contribute to make the affective reaction somewhat more complex than the reaction to other osmyls in the series. In one subject musk produced a violent aversive reflex and an " egocentric " " horrid "—a not infrequent occurrence with such osmyls as asafoetida or carbon bisulphide—while in another the first sniff caused a laugh reaction which accompanied or perhaps preceded the recollection of an exceptionally happy scene of " auld lang syne." Laugh reflexes to pleasant scents are more usual in children, adults merely smile, sometimes. In yet another subject musk was considered pleasant and an entirely unpleasant scene was recalled.

All the experiments tend to show that an increasing knowledge of mean affects to a wide range of odors, and of olfactory syndromes, in health and disease, will provide many data of diagnostic value. The question particularly of the relation between odor preferences and state of physical and mental health, requires further elucidation.

VI. TYPES OF SMELL ASSOCIATIONS

In the course of the experiments the possibility of utilizing mental reactions to odors in psychotherapeutics become a matter of attention. The affective reactions demonstrated the possibility of inducing different " moods," the odor of rose oil being soothing, tranquillizing, causing a sense of well being in most of the subjects; musk, a veritable chameleon of odors, sometimes pleasing, sometimes irritating, at other times causing a reflective mood; the tang of pine oil bracing and friendly; ferric valerian uncomfortable; vanillin " drowsy." " Il est," sings Baudelaire,—

> " Il est des parfums frais comme des chairs d'enfants,
> Doux comme le hautbois, verts comme les prairies;
> Et d'autres, corrompus, riches et triomphants,
> Ayant l'expression des choses infinies,
> Comme l'ambre, le musc, le benjoin et l'encens,
> Qui chantent les transports de l'esprit et des sens."

Induced " frames of mind " have their value in the treatment of certain neuroses, and odors carefully selected to produce a required " mood " would be quite as effective, perhaps more so, than the analogous color therapy.

The other application the experiments tend to point out is to deliberately utilize odorous stimuli in order to recall " forgotten " incidents, or to obtain an insight into a patient's mentality. Only a small number of the innumerable olfactory stimuli inspired with every breath, cause a reaction of which the individual is aware at the time; however, that a rection has been caused is demonstrable by applying identical or similar stimuli later, when the conditions prevailing formerly are reproduced, and the circumstance may more or less fully become the content of an image, often, but not invariably, of a visual character.

In 1922, one of the subjects was given some camphor to smell. He immediately felt mentally distressed and visualized at first, the door of a wardrobe, then the entire wardrobe, then the emotion of fear at being suffocated or being in the dark, remembered kicking and hammering at the door to be let out. It was as if curtains had been drawn aside and revealed more and more of the view. At the same time the subject showed a marked psychogalvanic reflex, the galvanometric deflection being right off the scale. The camphor stimulus had been present with each breath, during this act of punishment for a youthful misdemeanor, a scene that could be dated as having taken place in 1892 and which had not entered consciousness since. The subject now associates camphor with blankets, moth-balls, various wardrobes, articles of clothing, etc. The affective judgment was given as + — throughout.

Another subject on smelling xylol, visualized herself on board a vessel in a harbor in Ceylon. Here again the view, as it were, became more extensive and details were filled in, just as in lifting the eyes fom the deck to the houses and scenery ashore, and a growing awareness of all the environmental conditions. The odor of xylol resembles that of benzole, paraffin oil, etc., which emanates from harbor launches. The subject was not certain whether petrol launches had been present in this small harbor or not. The harbor had left a deep impression, so that an odor prevalent in many harbors and producing a harbor " atmosphere " or general harbor " mood " would tend to recall the particular harbor which affected the subjects more than others.

An analogue would be provided by word association, and the word harbor would be associated with the name of a particular harbor if the latter had exceptionally affected the subject. Associations of less expansive and more contracted content, such as vessel, sea, docks, safety, motor-launch, etc., might be given to the word harbor, or by the odor stimulus according to the object or circumstances affecting the subject. The word Kelvin, the name of a well-known marine engine was, in fact, associated to the smell of xylol by another subject, who was particularly " affected " by a cruise in a boat driven by that engine. In subjects of a more landlubberly disposition, the odor of xylol would affect them in a similar ways as a garage, and either the garage as a whole, or elements of the garage, such as petrol cans, cars, tires, or owners of cars, mechanics, the sound of a motor horn, etc., would be reproduced as an image, according to the way in which the subject had been affected. One subject, who associated xylol with the name of a friend, the owner of a motor car, gave a very marked psychogalvanic response.

The content of associations to cedarwood oil, showed many deviations from the common pencil association. A vivid image of a summer's evening, off the Norwegian coast, where the scent of coniferous trees is wafted far out to sea, the recollection of a long forgotten bazaar (via money and the cedarwood cigar box in which the money had been put), and school days (via pencils) are but a few of the more expansive associations recorded. The name of a road given with delayed association time by a subject to the cedarwood oil stimulus, was an association, the nature of which was obscure at first, but became evident on further analysis. When going to school years ago, the subject had been in the habit of walking along this road, chewing the end of a pencil; the road proved also to have been associated with an incident (occurring a few years later) frightening the subject, and which had been banished from consciousness until the experimental stimulus resulted in a distressing memory image. The affect given to the stimulus itself was the mean affect (+ —).

Cleaning floors with a cedar mop, or a larger image of spring cleaning, was not an uncommon reaction to cedarwood oil. In one subject, who proved to have a violent dislike to mops, a dislike it was outside the range of these experiments to analyze, cedarwood oil produced a — + affect, linked up with an emotion of fear.

A number of subjects gave synæsthetic reactions to odors, responding by an awareness of sensations belonging to a different sense. Amyl acetate produced the sensation of blue in subject No. 21, and a "hot red gorgeous color" in No. 36. Menthol was responsible for a cool sensation without odor in No. 3, rose oil for the sensation of sweetness to the exclusion of the specific olfactory sensation in a few other subjects. Sweet sensations were also caused on stimulation with tonka bean, amyl acetate, terebene, musk, and vanillin. Origanum was responsible for another case of a color sensation, a green opalescent hue being experienced by subject No. 22. Ferric valerian gave a sensation of soft " squashiness " to two different subjects, and camphor the sensation of woolliness. The latter cases were very possible associations of a contracted content, however, they are listed in Tables VII and VIII, under the heading synæsthetic reactions. A pseudo-synæsthesia was, undoubtedly, the sensation yellow experienced as a response to citronella, the yellow color sensation taking shape as the image of a lemon, a usual association.

Auditory synæstheses were also recorded. The sensation of a high note was caused by terebene, and a middle note " as if played with a soft pedal " was experienced by another subject,

Table VIIa.

Number of Associative Reactions of Male Subjects

OSMYL	SYN.	CON.	EXP.	IND.	EGO.	?	TOTAL
Amyl acetate	1	14	7		2	2	26
Amyl alcohol		8	3			3	14
Asafoetida		17	13		1	5	36
Benzole			1				1
Butyric acid		4	3			3	10
Camphor		16	10			4	30
Carb. bisulph			3			3	6
Cassia oil		3	3			1	7
Cedarwood oil		14	13		1	5	33
Citronella		13	9		3	5	30
Clove oil		12	14	1	2	2	31
Ethyl alcohol		10	2			3	15
Eucalyptus oil		1	3				4
Lavender oil		2	2				4
Menthol	1	18	5	1		7	32
Musk	1	9	15	1	3	7	36
Origanum oil	1	13	7		1	2	24
Orris root		1	3			2	6
Pine oil		13	9	1		3	26
Rose oil		23	10		3		36
Sandalwood oil		12	5		1	8	26
Terebene	1	14	7			3	25
Tonka bean		18	13			5	36
Ferric valerian		17	5		3	7	33
Vanillin		15	2		1	7	25
Xylol		10	14				24
Total	5	277	182	4	21	87	576
Percentage	0.9	48.1	31.6	0.7	3.6	15.1	100%

on stimulation with camphor. It is possible that the latter reaction is what might be called an indirect synæsthetic sensation, being primarily a soft woolly sensation (or association), the softness of the tactile sensation producing in this musical subject a "soft" auditory sensation of similar affective tone. A very high note heard by two or three subjects in response to citronella, proved to be the sound of mosquitoes, which are repelled by the odor of citronella.

Many subjects, on comparing odors, experience the sensation of "pitch," and experiments described elsewhere (Kenneth) show that sandalwood oil, cedarwood, origanum oil and terebene could be serially arranged, according to the sensation of pitch,

TABLE VIIb.

NUMBER OF ASSOCIATIVE REACTIONS OF FEMALE SUBJECTS

OSMYL	SYN.	CON.	EXP.	IND.	EGO.	?	TOTAL
Amyl acetate	2	27	4			2	35
Amyl alcohol		2	5		1	7	15
Asafoetida		15	9	1		7	32
Benzole		4	6				10
Butyric acid		2	1			1	44
Camphor	3	22	14			7	46
Carb. bisulph		5	3			2	10
Cassia oil		9	2			2	13
Cedarwood oil		24	16	1		4	45
Citronella		14	15			11	40
Clove oil		12	11	1		4	28
Ethyl alcohol		11	5		1	4	21
Eucalyptus oil		6	6				12
Lavender oil		11	2		2		15
Menthol		21	9		1	3	34
Musk	1	13	19	2	4	12	51
Origanum oil		14	7	1		5	27
Orris root		1	2			1	4
Pine oil		17	11	2		1	31
Rose oil	5	24	13	3	2	3	50
Sandalwood oil	1	11	3			12	27
Terebene	2	16	4		1	1	24
Tonka bean	1	18	12	2		9	42
Ferric valerian	2	14	9			18	43
Vanillin	3	19	4	1	1	5	33
Xylol		14	12	1		1	28
Total	20	346	204	15	13	122	720
Percentage	2.8	48.1	28.3	2.1	1.8	16.9	100%

among other sensations, the arrangement being in the order of the boiling points of these osmyls.

Associations with music were experienced in two cases, in one a few bars of Chopin were " heard " on stimulation with vanillin, in another the odor of pine oil was associated with Ireland's song " Sea Fever." Similar affective relations between odors and poetry also occurred.

Some odors, particularly flavors, are more or less restricted to the immediate neighborhood of the substance from which they emanate while others pervade a wider space. Thus the reaction to vanillin, custard, toffee, or chocolate, that to tonka bean, landscapes, the odorous principle of the tonka bean being coumarin, which has the smell of new mown hay. Odors that are met with

TABLE VIIc.

NUMBER OF ASSOCIATIVE REACTIONS—ALL SUBJECTS

OSMYL	SYN.	CON.	EXP.	IND.	EGO.	?	TOTAL
Amyl acetate	3	41	11		2	4	61
Amyl alcohol		10	8		1	10	29
Asafoetida		32	22	1	1	12	68
Benzole		4	7				11
Butyric acid		6	4			4	14
Camphor	3	38	24			11	76
Carbon bisulphide		5	6			5	16
Cassia oil		12	5			3	20
Cedarwood oil		38	29	1	1	9	78
Citronella		27	24		3	16	70
Clove oil		24	25	2	2	6	59
Ethyl alcohol		21	7		1	7	36
Eucalyptus oil		7	9				16
Lavender oil		13	4		2		19
Menthol	1	39	14	1	1	10	66
Musk	2	22	34	3	7	19	87
Origanum oil	1	27	14	1	1	7	51
Orris root		2	5			3	10
Pine oil		30	20	3		4	57
Rose oil	5	47	23	3	5	3	86
Sandalwood oil	1	23	8		1	20	53
Terebene	3	30	11		1	4	49
Tonka bean	1	36	25	2		14	78
Ferric valerian	2	31	15		3	25	76
Vanillin	3	34	6	1	2	12	58
Xylol		24	26	1		1	52
Total	25	623	386	19	34	209	1296
Percentage	1.9	48.1	29.8	1.5	2.6	16.1	100%

under both localized and general conditions tend to provide both limited and wider associations. Rose oil, for instance, may recall either the flavor of honey, the word honey, or an image of a pot of honey, or the word "scent," and such-like associations only, or it may recall the garden and the old folks at home. Cedarwood oil may affect the subject as a pencil would affect him, or as coniferous forests in British Columbia.

The association may be *via* an identical odor, as when the odor of camphor evokes the image of a bottle of camphorated oil, or of a sick-room,—or it may be *via* an osmyl of similar chemical constitution and affect, as when the odor of cassia oil recalls the smell of cinnamon. Or the odor may be associated with a totally

TABLE VIIIa.
NUMBER OF ASSOCIATIVE REACTIONS OF EACH MALE SUBJECT

SUBJECT NO.	SYN.	CON.	EXP.	IND.	EGO.	?
1		3	6		2	4
2		7	5			2
3	1	3	3			2
4		9	7		1	1
5		7	1		1	3
6		13	5		2	4
7		3	4		1	3
8		7	4			1
9		10	2		4	2
10		8	3			3
11		3	3	1	2	
12	1	68	67		1	15
13		7	3		1	6
14		7	7			4
15		4	6			
16		4	5		1	8
17		1				4
18		10	2			1
19		4	8			
20		11			2	2
21	1	10	6			
22	2	25	3	1		1
23		8			1	6
24			1			
25		17	10	2	1	7
26		13	5			2
27		4	10			
28		8	4			4
29		3	2		1	2
Total	5	277	182	4	21	87

different odor but producing the same affect, as when the smell of asafoetida recalls the school-house and the " stinks " of early delvings into chemistry. Or, again, the odor may be associated with objects *via* one of the other senses, especially taste.

The classification of associations due to olfactory stimuli presents many difficulties. While it would be possible to adopt a modified form of Jung's classification, it is proposed here to use a somewhat different method. One of the considerations emerging from these experimental investigations was to discover which of the osmyls used were liable to call up associations of the most varied character. The possibility was indicated to utilize a series of odors for purposes of psychoanalysis, owing to the vividness of mental images evoked, analogous to the use of word series. Thus the home, school, hospital, farm, church, war, and other constellations could be revealed by different odors. The odor of ethyl alcohol brought into consciousness a conflict between the desire to avoid alcoholic drinks and the desire to attend communion, the odor of musk frequently recalled persons of the other sex, musk may also recall the incense of a French cathedral, or asafoetida and ferric valerian the deficiencies of French sanitation at the Front, and so on ad infinitum.

It was, therefore, deemed practical to classify associative reactions as follows:

1. Synæsthetic Reactions:

Colored, gustatory, auditory, tactual, and thermic sensations, as described previously.

2. Contracted Reactions:

Identical or other odors or odorous objects associated, whether as words, visual images, or flavors, etc. *E.g.,* Pine oil—turpentine; Menthol—bottle of smelling salts; Amyl acetate—pear-drop, candy; Cedarwood oil—pencil; Orris root—bunch of violets, packet of tea.

3. Expanded Reactions:

Content of associations not limited to identical (or similar) odorous substance, the latter having been present whether that presence is recalled or not. *E.g.*, Pine oil—Norway; Amyl acetate—village (sweet-shop); Rose oil—garden; Rose oil—Bulgaria; Rose oil—home; Musk—Paris; Musk—Cathredal; Musk—cows and farm; Musk—Botany lessons; Musk—a certain person and place; Menthol—headache and sick-room; Asafoetida—kitchen, home, dining saloon on board a steamer, etc.; Menthol—eating peppermints at church.

4. *Indirect Reactions:*

Content of associations not limited to odorous substance, the latter having been absent. *E.g.*, Clove oil—Ekaterinburg (*via* toothache); Cedarwood oil—name of a road (*via* chewing pencil); Vanillin—Tennyson (*via* drowsiness and "The Lotus-eaters").

5. *Egocentric Reactions:*

Personal valuation of stimulus or association. *E.g.*, Rose—soothing; Musk—subtle; Musk—immoral; Ferric valerian—vile; Pine oil—good; Citronella—nauseating; etc.

6. *Doubtful Reactions:*

Table VII shows the number of associative reactions given in response to each osmyl, and Table VIII the number of associative reactions given by each subject. It will be noted that the ratio between contracted and expended reactions, varies considerably in the different osmyls, musk being remarkable for the relatively large proportion of expanded, as well as egocentric reactions. As was to be expected, such odors as amyl acetate, ethyl alcohol, and vanillin, evoked a relatively larger number of contracted associations than did asafoetida, camphor, cedarwood oil, or pine oil. Almost 30 per cent. of the 1,296 associative reactions were of an expanded nature.

The ratio between the different categories of associative reactions given by individual subjects (Table VIII) is of interest, and would be of diagnostic value, if a larger number could have been recorded. Subjects 9, 22, and 45, afford examples of the contracted type, Nos. 27 and 60, of the expanded type. The former is the more common condition met with, as are subjects whose contracted and expanded associations are approximately equal. A number of subjects, such as 35 and 54, did not possess good olfactory memories, but, in the aggregate, considering the general neglect of education of the sense of smell, the high percentage (83.9) of definite reactions given, is remarkable. It may be mentioned here, that cases in which, owing to catarrhal or other conditions, an odor was not perceived, are not included in any of the Tables, and were of rare occurrence (low intensity of orris root, for instance).

TABLE VIIIb.
NUMBER OF ASSOCIATIVE REACTIONS OF EACH FEMALE SUBJECT

SUBJECT NO.	SYN.	CON.	EXP.	IND.	EGO.	?
30		4				
31		10	5			
32	2	9	15	1		3
33	1	10	2			5
34	3	7	4	4		7
35	1	6	2			5
36	2	2	7	2	2	1
37		5	4		1	3
38		20	11	2		6
39	2	12	5	1	1	6
40		1	6			4
41		12	17			
42		5	1			4
43	1	9	5		1	15
44		3	5	1		
45		28	4			5
46	1	8	8			3
47		11	4			4
48		7	8	1		1
49	1	3	2			4
50		5	4			4
51	1	16	15			4
52		18	6		1	4
53		20	10		2	4
54	1	21	1			10
55	2	1	1		1	2
56		6	1		1	2
57		8	12			
58	1	6	1			
59	1	27	8		2	6
60		8	24	2		1
61		8	3		1	5
62		11	7	1		
63		4	2			2
Total	20	346	204	15	13	122

VII. ASSOCIATIVE REACTIONS TO THE DIFFERENT OSMYLS

Amyl Acetate. The majority of the reactions were limited to the image of pear-drops, a sweet-meat which, in some subjects, brought up memories of childhood, or to the odor of pears, benzole, and ether, with contracted or expanded reactions. An exceptional reaction word was Germany, which was associated with the smell of ether in a hospital, in which the subject had visited a patient, during her stay in that country.

Amyl Alcohol. Association words were—sherry, alcohol, ether, rotting potatoes, dental surgery, a dentist, camping out (smell of spirit lamp), methylated spirits.

Asafoetida. The usual association was—garlic, leek, or onions, with or without more expanded images. One subject visualized a tram-car in a street, a puzzling reaction, until it was remembered that the Edinburgh trams were formerly lighted by acetylene gas, the odor of which is of an alliaceous nature. The smell of rubber and expanded reactions due to the odor, were not infrequently mentioned, for instance, gymnastics at school, via rubber-soled shoes; or mending a punctured tire by the road-side on a hot summer's day, perhaps the landscape being visualized first; father in the hall at home, either due to kitchen odors, or the rubber mackintosh hanging in the hall. An interesting association was the word Monday, given as a reaction word by one subject; the explanation being that the menu in that household, which was visualized, has included broth containing leeks on the Monday preceding the experiment.

Benzole, as well as *Xylol,* were associated, as has already been pointed out, with other petroleum derivatives, and contracted and expanded associations of varied kinds (motor boat and motor car constellations). In women subjects, the act of cleaning a dress was a natural association, with or without images of places or persons.

Butyric Acid. In the cases where this osmyl did not cause too violent a reflex, rancid butter and vinegar were the obvious associations. To persons who had been in India, scenes in that country would be recalled (*via* ghee).

Camphor associations were all of a fairly obvious nature, such as moth-balls, moths, articles of clothing and furniture, mother rubbing the chest with camphorated oil, chemists' and second hand clothes shops, etc.

Carbon Bisulphide. The odor, when not too intense, resembles that of cabbages, and the associations given, center round cabbages or chemical laboratories. Port Said and Germany were reaction words connected with the cabbage odor.

Cassia Oil. The flavor of cinnamon and the use of cassia oil in pharmacy, explain the content of most of the associative reactions. In one case the face of a medical practitioner, long since dead, was clearly visualized. Faces and figures of persons, by the way, were frequently visualized with the utmost clearness, on stimulation with odors, which may, perhaps, afford an explanation for certain " spiritualistic " phenomena, especially if clothing belonging to an absent person were in the room where the séance was held.

Cedarwood Oil. The most familiar objects in this country made of cedarwood, are pencils and cigar-boxes, and cedarwood oil is used in biological laboratories and the odor familiar to most students, so that the nature of the majority of associative reactions is obvious. Several subjects betrayed a lack of discrimination between different essential oils of the terpene group, so that cedarwood oil is mistaken for turpentine or pine oil, and associations may be to any of the terpenes. Many of the associations were in the form of vivid images of scenes of travel, the smell of cedars, pines, firs, and other conifers forming, as it were, a symbol for the entire scene. Similar scenes were visualized in response to origanum, pine, and sandalwood oils, and to terebene.

Clove Oil. The majority of associative reactions could be traced to the use of cloves or clove oil in cookery, dentistry, and in the biological laboratory. The word science was given as a reaction in one instance. Domestic scenes and incidents, sometimes with an emotional content, were recalled in various instances. An indirect association with the town of Ekaterinburg via toothache was recorded.

Ethyl Alcohol. The majority of associations were of a very contracted nature such as flavor of port and other wines, medicines as vin. ipecac., the expanded reactions being mostly laboratory constellations.

Eucalyptus Oil. The odor was occasionally either confused or associated with camphor, pine oil, and turpentine, and the medicinal use of this osmyl pervaded the associative reactions. Various travel scenes were also revealed, and names of countries and towns given as reaction words.

Lavender Oil. The associations from a scented handkerchief to a garden or room at home were obvious. An association of interest was that given by a subject, who did not recognize the lavender oil as such, but associated the odor with a bottle of Florida Water, which was visualized. The latter perfume contains 50 grains of oil of lavender in 5 quarts of alcohol, but also such odorous substances as clove oil (8 grs.) oil of bergamot (90 grs.) and 10 grains of oil of lemon, and in other receipts citronella is added.

Certain associations to rose oil were due to this detection of one of the constituents of the essential oil, such as geraniol (scented geraniums) and citronellol.

Menthol. It was, unfortunately, not possible to ascertain whether the menthol crystals used were of American or Japanese origin. The latter has but a slight odor of peppermint as compared with the Michigan article. Associations were given both to menthol and to mint oil, by different subjects, as well as double reactions by the same subject. The medicinal use of menthol, and the use of peppermint sweets, were the usual objects of association. Whether the preponderance of peppermint reactions was due to the composition of the menthol, or, as is more likely, to the greater familiarity with peppermint, cannot be stated with conviction. Tactile sensations experienced were associated with those occurring with ammonia, and the sensation of coolness has been recorded. The expanded type of association to menthol centered round the home, school, church, and shops.

Musk. A few grains of animal musk were used as a stimulus, not the artificial musk, which has no chemical relationship with the compound responsible for the odor of the animal product, viz. muskone. One of the few words for the quality of an olfactory sensation, namely musty, is not merely etymologically connected with musk, but was given as description of the taste as well as odorous sensation by this stimulus. Moss, derived from the same language root, formed an associative reaction in the course of the experiments, in two subjects. Fusty, stale, mouldy, woody, clean, heavy, sweet, chokey, pungent, were some of the adjectives applied to describe the sensation; the sensation of pungency is probably due to the detection of a small trace of ammonia, a decomposition product of musk, but was only recorded in one case. A musk-like odor is widely met with in nature. Apart from mosses, fungi (mushroom, derived from mousse, moss), and other occurrences in the vegetable world, a musky smell emanates from cows, and also from human beings, under certain conditions, and all these sources are represented in the associative reactions. Musk is contained in incense, hence one vivid image of high mass in a French Church, during the war, by one subject, and another church associated by a second subject.

The human skin may exhale a musk-like odor as was shown in an interesting association by a subject who, immediately visualized a village dance, since "forgotten," at which he had touched a girl's hand for the first time in his life. It was a hot day and, in wiping his brow with his hand, he became aware of a new odorous sensation due to holding hands. Other subjects likewise visualized hospital patients, whose odor, they declared, was like the stimulus in the experiment.

Owing to the use of musk, both natural and artificial, in perfumery, persons were visualized, "a horrid woman," "a girl friend I quarrelled with because she used vile scent," "a delightful scent my fiancée uses," "the women at the corner of the Place de l'Opera in Paris," "a fragrant scent used at home," "a dressing room," were some of the associations given, one or two with a marked reflex.

One subject, in whom pine oil, rose oil, and other osmyls, caused but a small deflection (5 to 30 mm.) of the galvanometer, when stimulated with musk, registered a deflection right off the scale. The association was "a thick brown cloud, necromancy, and wizardry, and Parsifal." A full analysis was not possible, but it is believed that some domestic conflict, connected with spiritualism, was the cause. This was the second stimulation with musk (affect — +) the first reaction, about a month previously, having been a synæsthetic (?) one, or association of sweetness (affect + —). Two other subjects gave the reaction sweetmeats visualized to musk.

One subject thought of myrrh and frankincense and "something Eastern." The subject whose affective reactions to musk have been previously described, as having fluctuated from — + to + — and back again to — + associated musk first with cinnamon—musty smell, then with the taste of a lead pencil, the latter association recurring the week after. All these examples are indications that the reactions to musk alone merit experimental study on a large scale.

Origanum Oil yielded a comparatively poor crop of associative reactions; the possible origanum-green synæsthesia, and the recollection of a string quartette party at a private house—the connecting link being the odor of colophony—are the more interesting ones. Oil of origanum is really a misnomer since the essential oil extracted from Origanum Majorana, or marjoram, is not much used, and the name is applied to oil of thyme. A thyme plant was visualized by three different subjects, other associations being a botany department, varnish, floor polish, eucalyptus, camphor, turpentine, sandalwood oil, and the flavor of carraway seeds and aniseed cake, the latter flavor was also associated with medicines. The fact that origanum oil was unfamiliar to many subjects would tend to cause the odor to be associated with that of other terpenes, as the association " a windy day and firs or pines."

Orris Root. Only a few reactions were recorded, " like violets," " like tea " (packet visualized), " the smell of an elephant at a distance." The faint fragrance was associated, in one case, with an old lady.

Pine Oil. Owing to stimulation of endings of the fifth nerve, some associations were produced with odorous substances having the same property, such as—" the smell reminds me of a laboratory with a faint smell of chlorine." Burning incense in a definite church was visualized by another subject, who regarded both incense and pine oil as " rough " smells, but here there is a greater participation of the olfactory sense in the formation of the mental image. Camphor, turpentine, and other substances of the terpene group, were usually associated, either as a contracted memory of such stimuli in their household or medicinal form (flavor), or more expanded images were called up. The odor of pines was recognized by comparatively few subjects, and, as with cedarwood oil and some of the other osmyls, expanded and detailed memories of different places, according to the subject's travelling experiences, were recalled.

Rose Oil. A small bottle which had contained pure Bulgarian otto of roses was used, and many of the associative reactions have already been given. Roses themselves were only infrequently associated, more frequently toilet preparations, and sweets. A vivid image of the Indian market at Durban, and the hum of voices, was experienced in one case. Another subject remembered a particular purple sweet, offered as a bribe to overcome some sulkiness, and a large constellation was visualized which could be relegated to an exact date (1907).

Sandalwood Oil. The odor of this essential oil was unfamiliar to a large number of the subjects, and the associative urge, as it were, was directed towards objects and events linked with substances of a similar nature, such as pencil (*via* cedarwood oil), or " a lump of camphor." One subject, who was tested on several occasions, gave no associative reaction the first time, and on subsequent occasions gave the first test or the laboratory associations. There was shifting of the affect from — —, to — + and + —, which returned to a final verdict of — +. Subjects who had experience of Oriental travel, gave such associations as a street through an Indian bazaar, Singapore, or India. Less expanded associations were given in which figured objects, such as boxes made of sandalwood, or a sandalwood fan at home. Other subjects were reminded of flavors of some condiment.

Terebene. The usual association was connected with the flavor of lime juice cordial, and expanded as well as contracted associations were recorded. The reaction word "Armistice Day," and symbolizing a very large association content, was given by one subject, who, on introspection, remembered an incident connected with lime juice as having occurred on that day. Associations *via* other terpenes were common. In one case, a sawmill in British Columbia and the sound of the saw was recalled, as it also could be on stimulation with pine or cedarwood oil. " Lime juice " or " lemon squash " were the usual association reactions, however, as were certain sweet-meats, and confectioner's shops.

Tonka Bean. As has been mentioned before, this odor is a " landscape smell," being that of a new mown hay, also similar to that of cherry-wood. The latter resemblance was responsible for the association with the Manchester tobacconist, who had sold the subject concerned a cherry-wood pipe, and the association given by another subject of cherry trees. The former association may have been due, however, to the smell of snuff. Burnt sugar, marzipan, smell of almond skins, licorice, lavender, heather, and South African stinkwood, were given as associations. A naked Kaffir and his kraal were vividly visualized by a subject whose reaction word was "kraal." Owing to the widespread use of tonka bean or coumarin in the soap industry, "soap" and "washing hands" were among the associations given to this osmyl.

Ferric Valerian. This unpleasantly smelling drug is liable to drag up unpleasing associations dealing with stercoraceous matters. The usual association given in the experiments was Gorgonzola, or Limburger cheese. As with asafoetida and carbon bisulphide, some subjects were reminded of the lessens on "stinks" of their school days, which were, according to the subject, more or less visualized. One subject was reminded of a visit to a sugar refinery, another of an old vault, another of the odor of veratrin. An ash heap, a dead rat, cats, sour milk curd, fertilized fields, the kelp works near Oban, and locust beans in a granary, were among the associations given.

Vanillin. The usual content of associative reactions to vanillin were custard, chocolate, toffee, etc., and the majority of the associations were of a very contracted type. One subject visualized a meadow and flowers, another a bag of rice in a grocery store.

Xylol. Much that has been said about benzole also applies to xylol. The odor is familiar to students working in laboratories, and various university departments were visualized by different subjects. Motor car associations were also frequent.

VIII. CONCLUSIONS

A number of considerations arise from the experiments made, and while further experimental investigation is needed with regard to the various problems mentioned, it is possible to draw certain definite conclusions.

Each odor causes a feeling of pleasantness or of unpleasantness, an affect characteristic of the stimulus, and which may be expressed by the mean of the affective reactions given by an adequate number of subjects. The degree of pleasantness or unpleasantness may also be expressed by the percentage of the number of pleasant affects recorded.

The affect is dependent on many factors, partly connected with the osmyl, such an concentration and chemical stability, and partly connected with the subject, such as health, sex, and the affective tone of associations. These factors are to a large degree interdependent, as when catarrhal or catamenial and other conditions influence respiratory air currents and thereby intensity of the stimulus.

While no sexual differentiation was marked in the reactions to the majority of stimuli used in the experiments, such a differentiation may be observed in the case of a few osmyls, such as cedarwood oil, camphor, menthol, musk, and valerian.

While each odorous stimulus possesses an affective power characteristic of the stimulus, each subject has an olfactory affective syndrome characteristic of the subject. Marked deviations in a subject, from the mean affect to any given odor, are symptomatic of special physical or mental (*e.g.,* associative) conditions, transitory or permanent.

Although the sense of smell was not specially educated in the majority of subjects, a large number of associations revealing the correct appreciation of olfactory sensations were given.

It was found expedient to classify olfactory associative reactions in the six categories: synæsthetic, contracted, expanded, indirect, egocentric, and doubtful. More detailed classifications based on the paths of association, or strictly conforming to Jung's classification of associations, are possible, but difficult (*e.g.*, are some associations, like cedarwood oil, pine oil, sandalwood oil, not comparable to clang reactions in certain cases?).

The ratio between contracted and expanded reactions varies considerably in response to the different osmyls, as well as in the different subjects.

It is possible to use smell-word associations for analytic purposes in the same way as word-word associations, in suitable subjects. Owing to the pervasiveness of odors, suitable stimuli associated with most phases of human life could be selected to recall specific places, events, or persons, directly or indirectly.

An odor constitutes a more effective way of characterizing an object or place than a verbal description; however, the absence of a vocabulary of olfactory sensations raises difficulties.

Association time and psychogalvanic phenomena can be utilized with associative reactions to odors, as with reactions to words.

The purely affective nature of many associative reactions to odors is indubitable, and is indicated in the case of various associations usually interpreted in another way.

The fact that most olfactory associations are formed unconsciously makes their investigation one of some considerable practical importance, especially when linked up with the olfactory associations occasionally recorded in dreams.

It is desirable that the mean affect due to as many different odors as possible, as well as different intensities of the same odor, should be determined in different races, also the nature and extent of the associations formed.

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